Interrelationship between Prior Knowledge and Language Proficiency in L2 Listening Comprehension

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Chung, Hyun-Sook. 2001. **Interrelationship between Prior Knowledge and Language Proficiency in L2 Listening Comprehension.** *Korean Journal of English Language and Linguistics* 1-1. 187-209. This study attempts to supplement what is known about the influence of prior knowledge on second language listening comprehension. To do so, the study examines the effect of prior knowledge and language proficiency on the ability of L2 listeners to understand texts. The purpose of an experiment was to determine the effect of topic familiarity on the L2 listening comprehension ability of subjects who varied in L2 listening proficiency level. The subjects (N=117) were selected from a population of college students enrolled in the Departments of English and Business in Korea. English listening proficiency levels were designated on the basis of TOEFL listening scores. Subjects listened twice each to texts (more familiar and less familiar). After listening to each text, a ten-item objective test was administered to test the subjects' comprehension of the information presented in the text. Objective tests were analyzed using repeated measures analysis. A post hoc test was conducted to identify the means that were significantly different. This study yielded the following results: (1) subjects with high prior knowledge comprehended texts significantly better than did subjects with low prior knowledge; (2) the level of L2 listening proficiency had a significant effect on the L2 listening comprehension of texts, but there was no interaction between prior knowledge and the level of L2 listening proficiency.

1. Introduction

Researchers frequently note the importance of listening comprehension by observing that infants are capable of responding to a significant amount of language long before they

produce speech. Once the child is ready to speak, progress is nothing short of astounding, given the complexity of language. Lately, moreover, scholars have begun to apprehend the critical role listening plays in second language acquisition and learning. Obviously, any language that one has already learned to some extent, or perhaps even mastered, can be presumed to influence the degree of listening comprehension in a new language being studied. In learning a second language, just as in learning the first, the learner must gain entry into a new form and/or meaning system. The emphasis, then, is on form and meaning, which are customarily attended to as inseparable units in real language use (Byrnes 1984).

Second language learners frequently find themselves immersed in an environment in which they are certain about very little they hear and in which they must often rely on partial information, guesswork, and luck in their attempts at interaction (Long 1990). Second language learners, therefore, use strategies in different phases of comprehension as a response to specific processing problems. One of the most important strategies appears to be that of relating the new information grasped in the L2 listening task to the listeners' prior (or background) knowledge. This prior knowledge has been stored in memory and forms the basis for expectations or predictions about the interpretation of the discourse. Appropriate prior knowledge might provide the listeners with the frames of reference into which they can fit the bits and pieces of what they are trying to comprehend (Long 1989).

The present study is an attempt to add to what is known about the influence of prior knowledge on second language listening comprehension by examining the effects of prior knowledge and listening comprehension proficiency on how well second language listeners understand texts. Specifically, the study is an attempt to determine whether (1) prior knowledge of a text

and (2) the level of listening comprehension in English affect in positive, negative, or neutral ways the comprehension of information presented orally to Korean second language learners. This research focuses on the effect of prior study of a topic on the comprehension of a text on that topic. Additionally, the analysis of data addresses whether listening skills affect whether students can access prior knowledge of a topic and thereby enhance their listening comprehension.

To address this issue, the current study poses the following research questions:

1) Would scores on a listening measure be higher when second language learners are familiar with the content of the texts that they have heard than when they are not?
2) Would the effects of topic familiarity vary with students' L2 listening proficiency levels?

2. Previous Research on the Effects of Prior Knowledge on L2 Listening Comprehension

Even though only a small research base in schemata-theoretic listening presently exists in the L2 listening comprehension literature, some research has been conducted into the role of prior knowledge and schemata, which exist in memory, which are organized around a theme, and which are used in a wide variety of situations as a framework for understanding incoming information. These research studies have demonstrated the importance of activating the knowledge framework of listeners prior to asking them to listen to a segment of spoken discourse. To make sense of the rapid-fire noise that comes from oral speech, learners often try to find an overall schema. Even at the word, phrase, or sentence level, students attempt to associate

prior knowledge of the content with the incoming noise (Rubin 1994).

The issues represented in the empirical studies seem to be (a) whether prior knowledge is a significant factor in L2 listening comprehension, and (b) whether listeners need a high proficiency level in the language to be able to use their prior knowledge.

The studies of Markham and Latham (1987), O'Malley et al. (1989), Long (1990), and Schmidt-Rinehart (1994) found that prior knowledge had a main effect on L2 listening comprehension; however, Long and O'Malley et al. found that schemata can also have dysfunctional effects on listening comprehension. If the text reminded students of something they knew well, they sometimes became so involved in recalling prior knowledge that their attention wandered from the listening task, and in some cases the listeners overextended their schema onto text information that was clearly incongruent.

The studies of Chiang and Dunkel (1992) and Jenson and Hansen (1995) found that subjects' performance did not differ significantly whether the text presented was on a familiar or unfamiliar topic. Their findings did not support the hypothesis that L2 listeners who have indicated prior knowledge of a topic will perform better on listening comprehension than listening skills alone would predict. Hence, the effects of prior knowledge on listening comprehension are somewhat unpredictable.

Research investigating the effect of background knowledge at different proficiency levels is contradictory. According to Jenson and Hansen (1995), L2 listeners with higher proficiency are more likely to be able to use their knowledge of the world and of the language to decode, interpret, and integrate new information successfully. Their study, however, indicated a higher L2 listening skill was not needed to access one's prior knowledge of the topic. Schmidt-Rinehart's (1994) study also found that all subjects, regardless of their course level, scored higher on

familiar passages. In contrast, O'Malley et al.'s (1989) study found that the effective L2 listeners made use of both top-down and bottom-up processing strategies, while ineffective L2 listeners became embroiled in determining the meaning of individual words. Thus, the following question remains to be answered: Do more proficient L2 listeners use knowledge-based processing to the same degree as less proficient L2 listeners?

3. Method

3.1 Subjects

Subjects for this research were selected from the population of college students in Korea. The subjects were drawn from six different classes. All subjects were nonnative speakers of English and had studied English as a foreign language for at least six years during middle school and high school. Initially, there were 125 subjects, but 8 subjects were not included in the statistical analysis. According to the background questionnaire, four subjects reported that they had taken both an *Introduction to Linguistics* course and an *Introduction to Statistics* course. In addition, four subjects were not included because they did not attempt one or more of the tasks. Thus, the data accrued on those 8 subjects were not included in the statistical analysis. In all, the performances of the remaining 117 subjects on the postlecture comprehension test composed the data set. Subjects were students in either the Department of English or the Business School.

For purposes of discussion in this study, listening proficiency in English was divided into three levels on the basis of the subjects' performance on the listening section of the Test of English as a Foreign Language (TOEFL), the possible range of which is 24 to 68. Subjects who scored between 52 and 68 were assigned to the advanced level; those who scored between 43 and 51 were

assigned to the intermediate level; and those who scored between 24 and 42 were assigned to the low level. The category names *advanced, intermediate,* and *low* are used for comparison within this study only and they do not refer to similar terms used in the *ACTFL Proficiency Guidelines.* The test was administered according to the instructions provided and within the 35-minute time limit allowed by the Educational Testing Service.

3.2 Materials

Materials for this study consisted of the background questionnaire by which personal background information was collected, the listening section of the Test of English as a Foreign Language (TOEFL), two listening passages adapted from textbook reading passages, and two ten-item objective tests.

In the background questionnaire, subjects were asked to provide information about their age, gender, area of study, and other related questions. This information was used in later analysis to determine if additional factors beyond language proficiency and prior knowledge might also influence subjects' comprehension outcomes.

The first textbook passage, one hypothesized to be more familiar to the subjects whose major was English, was adapted from 'What Is Language?' in *An Introduction to Language* (1988). The second textbook passage, hypothesized to be more familiar to the subjects whose major was Business, was adapted from 'Statistical Data' in *Introduction to Business and Economic Statistics* (1985).

The passages used for the experiment were recorded by an American female adult. The speaker was given guidelines for content and asked to speak in a conversational manner, as if she were explaining a passage to the students. The text was not read aloud from a script, nor memorized or rehearsed. In this way, the speech elicited approached authenticity in that it contained

characteristics of natural, informal speech, such as redundancies, pauses, self-corrections, false-starts, and varying word rate and intonation patterns. This informal register was chosen because learners are likely to be exposed to this type of speech as they interact with native speakers (Schmidt-Rinehart 1994). The speaker audiotaped the two passages, each of about two and half minutes with an average word rate of 130 words per minute. Two native speakers of English listened to the audiotapes and verified that the speech sounded natural with few discernible adjustments made to make it more comprehensible for nonnative speakers. The passages were transcribed into written form afterwards by another native speaker for purposes of analysis.

The language input across the two passages had to match as closely as possible in terms of the number of words, the amount of topic-specific vocabulary, and complexity of language. The Flesch Reading Ease rates text on a 100-point scale; the higher the score, the easier it is to understand the document and most standard documents aim for a score of approximately 60 to 70. The Flesch-Kincaid Grade Level rates text on a U. S. grade-school level, and a score of 8.0, for example, means that an eighth grader can understand the document. Both readability measures available in Microsoft Word 97 were used to determine the level of difficulty and consistency of the language in each passage. Results of analyses of the passages indicated that the Linguistics passage was made up of 311 words, 24 sentences, 12.9 words per sentence, a delivery rate of 133 words per minute, a Flesch Reading Ease score of 59.0, and a Flesch-Kincaid Grade Level score of 8.2. The Statistics passage was made up of 290 words, 24 sentences, 12.0 words per sentence, a delivery rate of 126 words per minute, a Flesch Reading Ease score of 51.0, and a Flesch-Kincaid Grade Level score of 9.1.

Comprehension was measured by a comprehension test

containing ten objective (i.e., short answer, true/false, and multiple-choice) items. Short-answer responses were not scored on spelling correctness, but on accuracy of content. The researcher-designed comprehension measures tested how well subjects could recall information and draw inferences from information in each of the passages. For each subject's response to the objective comprehension questions, one point was awarded for each correct answer, and a zero was awarded for each incorrect answer. Unanswered questions also received a zero. To determine test reliability, the author assessed internal consistency of the comprehension measures for each of the two passages by using Cronbach's Coefficient Alpha, in which the variance of all subjects' scores for each item is computed, and then these variances are added across all items. To assess subjects' prior knowledge of each text, assumptions were made about background knowledge based on declared majors and courses taken previously. In other words, students simply answered a yes/no question as to whether they had studied the topic of the lecture before.

3.3 Procedure

Subjects were tested in their normal classroom environment. Presentation order of the two experimental passages was counterbalanced to avoid any effect of practice on the overall results. Thus two different orders were generated to minimize the effect of order, that is, listening to the passages in a certain sequence, and different classes were assigned to one of those orders. In Order 1, the passage hypothesized to be more familiar to the subjects was presented first and the passage hypothesized to be less familiar to the subjects followed. In Order 2, the order was reversed; the less familiar was first, followed by the more familiar text.

After filling out the background questionnaire, the subjects

were assigned an identification number. In this way, their participation and performance remained anonymous and would not affect their final grade in the course. The sequence of events for those in Order 1 group was as follows: Prior to listening to the experimental passages, a short audiotaped, warm-up text was provided in order to familiarize the subjects with the speaker's voice. After that, the subjects listened twice to the audiotaped passage hypothesized to be more familiar to them, and they were permitted to take notes while listening to the passage in order to eliminate memory storage problems.

After the second playing, measures were administered to capture the subjects' comprehension of the speech information presented on the topic. They answered ten objective questions. The ten objective questions were spoken twice to the subjects by the English native speaker on tape, and the alternatives were given to them in written form on an answer sheet. To enhance the reliability of the test, the subjects were instructed not to use guessing strategies. The identical procedure was followed for the other passage hypothesized to be less familiar to the subjects. In the meantime, subjects in Order 2 group listened to the passage hypothesized to be less familiar to them first and then listened to the passage hypothesized to be more familiar to them. Other than the different order in which texts were presented, the identical procedure was followed as for Order 1 group. As a final step for both groups, the TOEFL was administered to measure subjects' listening proficiency.

3.4 Data Analysis

As stated previously, the responses to the objective comprehension questions were scored using the following two-point scale: 1 point = a correct answer; 0 point = an incorrect answer or no response. The data analysis employed a 2 x 2 x 2 x 2 factorial analysis of variance with repeated measures

in order to test the significance of means achieved by the six different groups of subjects on two different topics (more familiar versus less familiar topic). The L2 listening proficiency Level (intermediate versus low), Major (English versus Business), and Order (Order 1 versus Order 2) were between-subjects factors, and Topic familiarity (more familiar topic versus less familiar topic) was the within-subjects factor. The dependent variable was the scores on the postlecture objective comprehension test.

4. Results

Data in the form of the number of correct answers to ten objective comprehension questions for each lecture were collected for each of the 117 subjects. The assessment materials for the L2 listening comprehension test consisted of a ten-item objective test. For objective test data, a factorial analysis of variance with repeated measures using the SPSS computer package was performed. A post hoc test (pairwise comparisons) was also conducted to determine which of the means were significantly different from the others. The level of significance for all tests was set at .05.

4.1 Overall Analysis

A 2 x 2 x 2 x 2 factorial analysis of variance with repeated measures was computed to test for significant main effects and interactions across the different factors. Because there were no students at an advanced level, this analysis was conducted only for the data from an intermediate and a low proficiency level. The between-subjects factors were proficiency Level (intermediate versus low), Major (English versus Business), and Order (Order 1 versus Order 2). The within-subjects factor was Topic familiarity (more familiar versus less familiar). Table 1 shows the data

layout for this analysis.

Comprehension was measured by a ten-item objective test. The Cronbach's Coefficient Alpha computed to measure the reliability was .64 for the test of the Linguistics passage and .76 for the test of the Statistics passage. The descriptive statistics presented in Table 2 shows that there was a good amount of individual variability and a wide range of performance on the postlecture objective comprehension tests.

The complete source table for the factorial analysis of variance with repeated measures (see Table 3) reports the results of the main effects and interactions. For an alpha level of .05, the results show a highly significant main effect for Topic. The mean number of accurately answered items in listening to the Linguistics passage was substantially greater than the mean number of accurately answered items in listening to the Statistics passage. A similar strong significant result was found for Major. The English major group produced a substantially higher mean of accurately answered items than the Business major group; however, the significant interaction between Topic and Major must be taken into account when interpreting the significant differences between these two factors. Table 3 shows that the interaction Topic x Major was also significant. The cell means for all combinations of Topic x Major were shown in Table 4. In order to examine the significant interaction and determine exactly which combinations of Topic and Major were significantly different from the others, a post hoc test was used.

Table 5 shows the results of pairwise comparisons (t-tests were performed for pairwise comparisons) for the Topic x Major interaction. According to the results of pairwise comparisons across majors and across topics, the English major group produced a significantly larger mean number of accurately answered items for listening to the Linguistics passage than did the Business major group. For the Statistics passage, however,

both groups produced means that were not significantly different. In addition, for the English major group, the mean for the Linguistics passage was substantially greater than the mean for Statistics passage. Likewise, for the Business major group, the mean for the Statistics passage was significantly higher than the mean for the Linguistics passage.

TABLE 1. Data Layout with n in Each Group

Between-Subjects Variable			Within-Subjects Variable	
Group			Linguistics Passage	Statistics Passage
Intermediate Level (N=59)	English Major	Order 1	19	19
		Order 2	15	15
	Business Major	Order 1	13	13
		Order 2	12	12
Low Level (N=58)	English Major	Order 1	14	14
		Order 2	13	13
	Business Major	Order 1	15	15
		Order 2	16	16

TABLE 2 Descriptive Statistics

Level	Major	Order	Passage	Mean	SD
Intermediate Level (M=4.20)	English (M=5.57)	Order 1	Linguistics	6.89	1.37
			Statistics	3.05	1.39
		Order 2	Statistics	3.60	1.18
			Linguistics	8.73	1.58
	Business (M=2.84)	Order 1	Statistics	2.54	1.71
			Linguistics	3.00	1.68
		Order 2	Linguistics	2.12	1.80
			Statistics	3.67	1.37
Low Level (M=3.31)	English (M=4.69)	Order 1	Linguistics	6.57	1.95
			Statistics	2.43	1.40
		Order 2	Statistics	2.69	1.60
			Linguistics	7.08	1.55
	Business (M=1.94)	Order 1	Statistics	2.20	1.61
			Linguistics	1.67	1.88
		Order 2	Linguistics	1.44	1.26
			Statistics	2.44	1.75

TABLE 3. Source Table

Source	SS	df	MS	F	p
Between	817.1	116			
Level	45.78	1	45.78	15.77	<.001*
Major	431.9	1	431.9	148.7	<.001*
Order	10.74	1	10.74	3.70	.58
Level x Major	.013	1	.013	.004	.95
Level x Order	3.25	1	3.25	1.12	.29
Major x Order	7.30	1	7.30	2.51	.12
Level x Major x Order	1.59	1	1.59	.55	.46
Error	316.5	109	2.90		
Within	805.9	117			
Topic	200.1	1	200.1	98.02	<.001*
Topic x Level	.80	1	.80	.39	.53
Topic x Major	361.7	1	361.7	177.2	<.001*
Topic x Order	.72	1	.72	.35	.55
Topic x Level x Major	.002	1	.002	.001	.98
Topic x Level x Order	.18	1	.18	.09	.77
Topic x Major x Order	14.08	1	14.08	6.90	<.05*
Topic x Level x Major x Order	5.81	1	5.81	2.85	.09
Error	222.5	109	2.04		

TABLE 4. Cell Means of the Objective Test Scores for the Interaction between Topic and Major

	Linguistics Passage	Statistics Passage
Business	2.068	2.711
English	7.319	2.943

TABLE 5. Pairwise Comparisons for the Interaction between Topic and Major across Topic and Major

	Topic		
Major	Linguistics	Statistics	Difference
English	7.32	2.94	4.38*
Business	2.07	2.71	.64*
Difference	5.25*	.23	

The results also indicate a highly significant main effect for Level. The intermediate-level group produced a significantly higher mean number of correct answers than the low-level group. However, interaction between Topic and Level was not significant. In other words, topic familiarity effects did not vary according to the level.

Because Topic, Major, Level, and Topic x Major interaction were statistically significant, their practical significance could be determined. It was found that Topic explained 47% of the variance, Major 58% of the variance, and Level 17% of the variance in the dependent variable (scores on the postlecture objective comprehension test). In addition, it was found that the Topic x Major interaction explained 62% of the variance in the

dependent variable, which was a considerable amount.

4.2 Answers to Research Questions

1) Would scores on a listening measure be higher when second language learners are familiar with the context of the texts they have heard than when they are not?

This question was addressed through the analysis of the data obtained in the experiment. From a factorial analysis of variance with repeated measures conducted to find the main effect of Topic and Major and the interaction between Topic and Major, it was determined that there was a significant difference between scores on a listening measure of a more familiar topic and scores of a less familiar topic; that is, both groups produced a substantially greater mean of accurately answered items on the postlecture objective test for the more familiar topic than on the test for the less familiar topic.

2) Would the effects of topic familiarity vary with students' L2 listening proficiency levels?

The overall data analysis using a factorial analysis of variance with repeated measures indicated no interaction between the two independent variables, Topic and Level. All subjects, regardless of their L2 listening proficiency level, scored higher on the postlecture objective test for the more familiar topic. In other words, results indicate that whether or not the L2 listeners had prior knowledge about the topic had a significant effect on the comprehension scores regardless of their L2 listening proficiency level. Thus, topic familiarity emerged as a significant factor at all levels of L2 listening proficiency included in this study. Yet, it should be noted that L2 listening proficiency also played a

prominent role in comprehension when appropriate schemata were not available to the listener.

5. Conclusion

5.1 Discussion

Based on the results of numerous L2 reading studies and of a few L2 listening studies, one would hypothesize that topic familiarity would influence L2 listening comprehension. As in previous research, this study demonstrated that prior knowledge had a main effect on subjects' performance on the postlecture comprehension test. One striking finding in this study, however, is that prior knowledge correlated more strongly with comprehension scores for the Linguistics passage than for the Statistics passage. Furthermore, the results of the post hoc analysis on the interaction between Topic and Major indicated that the English major group significantly outperformed the Business major group on the postlecture comprehension test of Linguistics, while the Business major group did not significantly outperform the English major group on the postlecture comprehension test of Statistics.

Why does prior knowledge of Statistics not help the Business major group on the postlecture comprehension test? Let us consider the results of the background questionnaire. The textbook for the Statistics course was not written in English and technical terms in English were not used during the course. Learners who are exposed more to the target language are better able to integrate new messages and prior knowledge; however, the Business major group's lack of exposure to the statistical concepts in English terminology could have reversed the expected strong, significant contributions to comprehension of the Statistics passage. The difficulty of a comprehension task may have been exacerbated by the Business major group's lack of

adequate exposure to the target language.

5.2 Implications

The results of this study suggest several implications regarding classroom instruction. The effect of prior knowledge on L2 listening comprehension strongly suggests the need for more emphasis on content in L2 listening tasks in the classroom. Results for the first research question in particular indicate that the more a student knows about a given topic, the better chance he or she has of understanding a new text on that topic. The number of facts alone, however, may not be sufficient for increased L2 listening comprehension. Therefore, teachers should attempt to go beyond the imparting of information and guide the students in discovering the structure of the disciplines. For example, the teacher can aid the transfer of knowledge from one context to another by using analogies, examples, illustrations, and prior discussion, in which the teacher draws from what the listener already knows about a topic before giving a lecture.

An additional implication for educational practice is the importance of students having textbooks that are on their instructional L2 listening level in all subjects. This research indicates that college students have much more difficulty comprehending information if that information is presented in the language that they are not used to in the classroom and if the readability of the passage is beyond their proficiency level.

5.3 Limitations

As with all experimental research, several constraints in the design and administration of the measures used in this study might limit the interpretations of the data. Although the passages were parallel in source, length, and readability, there was no structural analysis of the passages. The effect of text structure on

L2 listening comprehension might explain why the Statistics passage was the hardest of all the tasks.

One potential weakness in the design is that Business major subjects who used the textbook written in English for the Statistics course were not available. Additionally this research dealt with only two topics, one each from the areas of Linguistics and Statistics. Therefore, conclusions cannot be generalized to topics in other disciplines. Moreover, this research was conducted with native speakers of Korean with varying levels of English language proficiency. It must be kept in mind that any conclusions drawn from these findings may be different with speakers of other language. Results of this investigation should be considered in light of the population studied (Korean college students), and the finding may not be reflective of students learning other languages.

Finally, the reliability of the postlecture objective comprehension tests was not equal across two passages. Cronbach's Coefficient Alpha is affected by the length of the instrument, such that it increases with the number of questions. Because each of the two objective comprehension tests had only ten questions, the reliability coefficients were not expected to be high. Probably, the internal consistency for the comprehension measures could have improved with a greater number of questions.

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접수일자: 2000. 11. 25.
게재결정: 2001. 1. 15.

APPENDIX

Background Questionnaire

Directions: Please fill out the information as requested below. All personal information will be kept strictly confidential and used exclusively for the purposes of the study.

1. Gender (circle one): Male Female
2. Classification (circle one):
   Freshman Sophomore Junior Senior
3. Age:
4. Field of study:
5. Have you ever taken TOEFL test?
   (circle one) Yes No
6. Have you ever taken Introduction to Linguistics course?
   (circle one) Yes No
   Was the textbook for this course written in English?
   (circle one) Yes No
   Were English technical terms used in this course?
   (circle one) Yes No
7. Have you ever taken Introduction to Statistics course?
   (circle one) Yes No
   Was the textbook for this course written in English?
   (circle one) Yes No
   Were English technical terms used in this course?
   (circle one) Yes No

Listening Test 1

Directions: Circle the letter (a, b, c, or d) that best answers the questions or answer the questions with a word. If there are any questions that you cannot answer, just leave them blank.

1. What is the sound system of a language called?
   a. lexicon b. morphology c. phonology d. semantics
2. What is the system of meanings of a language called?
   a. semantics b. phonology c. morphology d. syntax
3. What are the rules of word formation of a language called?

a. lexicon b. morphology c. phonology d. semantics

4. What are the rules of sentence formation of a language called?
   a. semantics b. syntax c. lexicon d. morphology
5. What do they call the way linguistic knowledge is used in actual behavior?
   linguistic _____
6. What do they call the grammar of a language that represents the unconscious linguistic knowledge or capacity of a speaker?
   _____ grammar
7. What do they call the grammar that attempts to teach you how to speak properly?
   _____ grammar
8. If you are interested in phonemes and allophones, which part of the grammar would you refer to?
   a. lexicon b. morphology c. semantics d. phonology
9. Which part of the grammar deals with how the past-tense is indicated in a verb?
   a. morphology b. phonology c. semantics d. syntax
10. If you want to know about a phrase structure rule, which part of the grammar would you refer to?
    a. morphology b. phonology c. semantics d. syntax

Listening Test 2

Directions: Circle the letter (a, b, c, or d) that best answers the questions or answer the questions in a word. If there are any questions that you cannot answer, just leave them blank.

1. What is a measure of a population variable called?
   a. parameter b. statistics c. skewness d. kurtosis
2. What is a measure of a sample variable called?
   a. statistics b. skewness c. kurtosis d. parameter
3. What do they call methods employed to summarize data?
   _____ statistics
4. When you base estimates or conclusions on samples drawn from a larger population, what are those estimates or conclusions called?
   statistical _____
5. When a scale uses numbers simply to identify observations as members of mutually exclusive groups, what do we call such a

scale?

a. interval scale b. nominal scale c. ordinal scale
d. ratio scale

6. When a scale uses numbers to rank each observation in a distinct relationship to the other observations, what do we call such a scale?
   a. interval scale b. nominal scale c. ordinal scale
   d. ratio scale
7. What do they call a scale that has an absolute zero point?
   a. interval scale b. nominal scale c. ordinal scale
   d. ratio scale
8. When you rank a group of 10 objects from largest to smallest with the numbers 1 to 10, which scale of measurement is being used?
   a. interval scale b. nominal scale c. ordinal scale
   d. ratio scale
9. Which scale of measurement will you use to measure variables such as sex, race, and geographic region?
   a. interval scale b. nominal scale c. ordinal scale
   d. ratio scale
10. What scale of measurement does miles per hour use?
    a. interval scale b. nominal scale c. ordinal scale
    d. ratio scale